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<b>2</b>	<b>0</b>	<b>(magnetic adj recording adj layer) and (superconducting adj layer) and (thermal or insulation)</b>	<b>USPAT; EPO; JPO</b>	<b>2004/06/17 11:08</b>
<b>3</b>	<b>8</b>	<b>(magnetic adj recording ) and (superconducting adj layer) and (thermal or insulation)</b>	<b>USPAT; EPO; JPO</b>	<b>2004/06/17 11:14</b>
<b>4</b>	<b>5</b>	<b>(magnetic adj layer) and (superconducting adj layer) and ((insulating or insulation) adj layer)</b>	<b>USPAT</b>	<b>2004/06/17 11:17</b>
<b>5</b>	<b>7</b>	<b>(magnetic adj layer) and (superconducting adj layer) and (heat or insulating or insulation)</b>	<b>USPAT</b>	<b>2004/06/17 11:20</b>
<b>6</b>	<b>45</b>	<b>(magnetic adj layer) and (superconducting) and (heat or insulating or insulation)</b>	<b>USPAT</b>	<b>2004/06/17 11:24</b>
<b>7</b>	<b>5</b>	<b>(magnetic adj layer) and (superconducting adj layer) and recording</b>	<b>USPAT</b>	<b>2004/06/17 11:25</b>

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	<b>Title</b>	<b>Current OR</b>	<b>Current XRef</b>
<b>1</b>	<b>Magnetic head including a core having a non-magnetic gap</b>	<b>360/120</b>	<b>360/122; 505/826</b>
<b>2</b>	<b>Magnetic head slider employing superconductor for levitation</b>	<b>505/171</b>	<b>360/122; 360/235.1; 360/235.2</b>
<b>3</b>	<b>Thin-film transformer utilizing superconductive components</b>	<b>505/211</b>	<b>323/360; 335/216; 336/200; 336/DIG.1; 505/870</b>
<b>4</b>	<b>Thin film magnetic head with improved flux concentration for high density recording/playback utilizing superconductors</b>	<b>505/171</b>	<b>360/119; 360/126; 360/129</b>
<b>5</b>	<b>Superconducting device for reading information from a magnetic recording medium</b>	<b>360/126</b>	<b>324/248; 505/845</b>
<b>6</b>	<b>Thin-film magnetic head including an inductive transducing element</b>	<b>505/171</b>	<b>360/120; 360/126; 360/127; 505/701</b>
<b>7</b>	<b>Thin-film transformer and magnetic head provided with such a transformer</b>	<b>505/171</b>	<b>336/84R; 360/120; 360/126; 360/127</b>
<b>8</b>	<b>Super conducting thin-film magnetic head including a magnetoresistive element</b>	<b>360/321</b>	<b>360/126; 360/319; 505/872</b>

	<b>Retrieval Classif</b>	<b>Inventor</b>	<b>S</b>	<b>C</b>	<b>P</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
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<b>1</b>	<b>Superconducting cable for alternating current</b>	<b>174/125.1</b>	<b>29/599; 505/230; 505/231; 505/232</b>
<b>2</b>	<b>High power factor shielded superconducting transformer</b>	<b>336/180</b>	<b>336/187; 336/200; 336/216; 336/83</b>
<b>3</b>	<b>Thin-film transformer utilizing superconductive components</b>	<b>505/211</b>	<b>323/360; 335/216; 336/200; 336/DIG.1; 505/870</b>
<b>4</b>	<b>Thin-film magnetic head including an inductive transducing element</b>	<b>505/171</b>	<b>360/120; 360/126; 360/127; 505/701</b>
<b>5</b>	<b>Thin-film transformer and magnetic head provided with such a transformer</b>	<b>505/171</b>	<b>336/84R; 360/120; 360/126; 360/127</b>

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<b>2</b>		<b>Johnson, Leopold J.</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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	<b>Title</b>	<b>Current OR</b>	<b>Current XRef</b>
<b>1</b>	<b>Superconducting cable for alternating current</b>	<b>174/125.1</b>	<b>29/599; 505/230; 505/231; 505/232</b>
<b>2</b>	<b>Spin interaction device</b>	<b>428/694ML</b>	<b>428/694IS; 428/694MM; 428/694RE; 428/694SC; 428/694TM; 428/701; 428/702; 428/900; 501/126; 501/152; 505/190; 505/238</b>
<b>3</b>	<b>High power factor shielded superconducting transformer</b>	<b>336/180</b>	<b>336/187; 336/200; 336/216; 336/83</b>
<b>4</b>	<b>Magnetic recording apparatus and magnetic head with superconducting material</b>	<b>505/171</b>	<b>360/125; 360/126; 505/701; 505/872</b>
<b>5</b>	<b>Thin-film transformer utilizing superconductive components</b>	<b>505/211</b>	<b>323/360; 335/216; 336/200; 336/DIG.1; 505/870</b>

	<b>Retrieval Classif</b>	<b>Inventor</b>	<b>S</b>	<b>C</b>	<b>P</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
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<b>7</b>	<input type="checkbox"/>	<input type="checkbox"/>	<b>US 4927804 A</b>	<b>19900522</b>	<b>7</b>

	<b>Title</b>	<b>Current OR</b>	<b>Current XRef</b>
<b>6</b>	<b>Thin-film magnetic head including an inductive transducing element</b>	<b>505/171</b>	<b>360/120; 360/126; 360/127; 505/701</b>
<b>7</b>	<b>Thin-film transformer and magnetic head provided with such a transformer</b>	<b>505/171</b>	<b>336/84R; 360/120; 360/126; 360/127</b>

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US005904979A

**United States Patent** [19]**Kakuishi et al.**[11] **Patent Number:** **5,904,979**[45] **Date of Patent:** **\*May 18, 1999**[54] **MAGNETIC RECORDING SYSTEM**[75] **Inventors:** **Yutaka Kakuishi; Kenichi Masuyama; Kiyomi Ejiri**, all of Kanagawa, Japan[73] **Assignee:** **Fuji Photo Film Co., Ltd.**, Kanagawa, Japan[ \* ] **Notice:** This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).[21] **Appl. No.:** **08/602,567**[22] **Filed:** **Feb. 14, 1996**[30] **Foreign Application Priority Data**

Feb. 21, 1995 [JP] Japan ..... 7-055174

[51] **Int. Cl.<sup>6</sup>** ..... **G11B 05/712**[52] **U.S. Cl.** ..... **428/328; 428/336; 428/403; 428/522; 428/694 BS; 428/694 BA; 428/900**[58] **Field of Search** ..... **360/88, 97.01, 360/113; 428/328, 336, 403, 522, 694 BS, 694 BA, 900**[56] **References Cited****U.S. PATENT DOCUMENTS**

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5,390,061	2/1995	Nakatani et al.	360/113

**FOREIGN PATENT DOCUMENTS**

0566100 10/1993 European Pat. Off. .

*Primary Examiner*—Stevan A. Resan*Attorney, Agent, or Firm*—Sughrue, Mion, Zinn, Macpeak & Seas, PLLC[57] **ABSTRACT**

(1) A magnetic recording system is disclosed, which comprises a thin-film magnetic head and a magnetic recording medium comprising a nonmagnetic support having thereon a magnetic layer comprising mainly ferromagnetic particles and a binder resin, wherein said binder resin comprising mainly a vinyl chloride resin, and said ferromagnetic particles are surface-treated with at least an organic compound.

(2) Another magnetic recording system is disclosed, which comprises a thin-film magnetic head and a magnetic recording medium comprising a nonmagnetic support, a nonmagnetic layer comprising mainly inorganic nonmagnetic particles and a binder resin over the nonmagnetic support, and a magnetic layer comprising mainly ferromagnetic metal particles and a binder resin over the nonmagnetic layer, wherein said binder resins in said magnetic and nonmagnetic layers each comprises mainly a vinyl chloride resin, said ferromagnetic metal particles are surface-treated with at least an organic compound, and said magnetic layer has a thickness of from 0.05 to 1.0  $\mu\text{m}$ .

**18 Claims, No Drawings**

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<b>2</b>	<b>Magnetoresistive random access memory and method for reading/writing digital information to such a memory</b>	<b>365/158</b>	<b>365/171; 365/173</b>
<b>3</b>	<b>Scanning magnetic microscope having improved magnetic sensor</b>	<b>324/244</b>	<b>324/210; 324/252; 324/750</b>
<b>4</b>	<b>Highly spin-polarized chromium dioxide thin films prepared by CVD using chromyl chloride precursor</b>	<b>427/255.31</b>	<b>427/255.36; 427/255.7</b>
<b>5</b>	<b>Magnetic tunneling structure having ferromagnetic layers of different crystallographic structure</b>	<b>360/324.2</b>	
<b>6</b>	<b>Keepers for MRAM electrodes</b>	<b>257/659</b>	<b>257/295; 257/390; 438/3</b>
<b>7</b>	<b>Superconducting cable for alternating current</b>	<b>174/125.1</b>	<b>29/599; 505/230; 505/231; 505/232</b>
<b>8</b>	<b>Keepers for MRAM electrodes</b>	<b>438/3</b>	<b>257/326; 438/692</b>

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<b>9</b>	<b>Magnetic lens apparatus for use in high-resolution scanning electron microscopes and lithographic processes</b>	<b>250/396ML</b>	<b>250/310; 250/398</b>
<b>10</b>	<b>Heat transfer apparatus and method employing active regenerative cycle</b>	<b>62/6</b>	<b>62/467</b>
<b>11</b>	<b>Integrable ferromagnets for high density storage</b>	<b>257/421</b>	<b>257/425; 257/431</b>
<b>12</b>	<b>Non-volatile MEMS micro-relays using magnetic actuators</b>	<b>310/40MM</b>	<b>310/DIG.6; 335/128; 335/78; 335/79; 335/80</b>
<b>13</b>	<b>Magnetic thin film and magnetic head using the same</b>	<b>428/692</b>	<b>324/252; 360/128; 428/694R; 428/694T; 428/694TS; 428/900</b>
<b>14</b>	<b>Method and apparatus for cooling GMR heads for magnetic hard disks</b>	<b>62/259.2</b>	<b>62/3.2; 62/3.7</b>
<b>15</b>	<b>Magnetic lens apparatus for use in high-resolution scanning electron microscopes and lithographic processes</b>	<b>250/396ML</b>	<b>250/310; 250/311</b>
<b>16</b>	<b>Process for producing magnetoresistive transducers</b>	<b>216/22</b>	<b>257/E43.006; 29/603.01</b>

	<b>Retrieval Classif</b>	<b>Inventor</b>	<b>S</b>	<b>C</b>	<b>P</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
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<b>10</b>		<b>Reid, Christopher E. J. et al.</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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<b>17</b>	<b>Self-aligned wordline keeper and method of manufacture therefor</b>	<b>365/158</b>	<b>365/171; 365/173</b>
<b>18</b>	<b>Magnetic recording system</b>	<b>428/328</b>	<b>428/336; 428/403; 428/522; 428/694BA; 428/694BS; 428/900</b>
<b>19</b>	<b>Magnetic field responsive device having giant magnetoresistive material and method for forming the same</b>	<b>324/252</b>	<b>360/326</b>
<b>20</b>	<b>Copolymers having magnetic properties</b>	<b>528/422</b>	<b>528/210; 528/271; 528/327; 528/331; 528/391; 528/399</b>
<b>21</b>	<b>Magnetic tunnel junction device with antiferromagnetically coupled pinned layer</b>	<b>365/173</b>	<b>257/E45.001; 365/158</b>
<b>22</b>	<b>Magnetic tunnel junction device with nonferromagnetic interface layer for improved magnetic field response</b>	<b>365/173</b>	<b>257/E45.001; 365/171</b>

	<b>Retrieval Classif</b>	<b>Inventor</b>	<b>S</b>	<b>C</b>	<b>P</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
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<b>23</b>	<b>Spin interaction device</b>	<b>428/694ML</b>	<b>428/694IS; 428/694MM; 428/694RE; 428/694SC; 428/694TM; 428/701; 428/702; 428/900; 501/126; 501/152; 505/190; 505/238</b>
<b>24</b>	<b>High power factor shielded superconducting transformer</b>	<b>336/180</b>	<b>336/187; 336/200; 336/216; 336/83</b>
<b>25</b>	<b>Magnetic recording medium</b>	<b>428/694B</b>	<b>428/694BA; 428/694BM; 428/694BN; 428/694BS; 428/900</b>
<b>26</b>	<b>Magnetic device and method for locally controllably altering magnetization direction</b>	<b>360/324.2</b>	<b>360/126</b>
<b>27</b>	<b>Magnetic tunnel junctions with controlled magnetic response</b>	<b>365/173</b>	<b>257/E45.001; 365/171</b>

	<b>Retrieval Classif</b>	<b>Inventor</b>	<b>S</b>	<b>C</b>	<b>P</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
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<b>28</b>	<b>Magnetic heads and magnetic recording reproducing devices using magnetic laminations</b>	<b>428/332</b>	<b>428/336; 428/694EC; 428/694IS; 428/694MM; 428/694R; 428/694TM; 428/694TS; 428/900</b>
<b>29</b>	<b>Method for preparing multilayer ceramic/glass substrates with electromagnetic shielding</b>	<b>156/89.17</b>	<b>156/89.18; 156/89.19; 156/89.21; 264/619; 427/131; 427/132; 428/426</b>
<b>30</b>	<b>Magnetic recording medium having a magnetic layer comprising hexagonal ferrite particles</b>	<b>428/329</b>	<b>428/336; 428/694BH; 428/694BM; 428/694BS; 428/900</b>
<b>31</b>	<b>Magnetic recording medium comprising a carbon substrate, a silicon or aluminum nitride sub layer, and a barium hexaferrite magnetic layer</b>	<b>428/408</b>	<b>428/694ST; 428/694TS; 428/900</b>

	<b>Retrieval Classif</b>	<b>Inventor</b>	<b>S</b>	<b>C</b>	<b>P</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
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<b>33</b>	<b>Superconductor magnetic reading and writing heads</b>	<b>505/171</b>	<b>360/120; 360/125</b>
<b>34</b>	<b>Diamond-like metallic nanocomposites</b>	<b>423/446</b>	<b>117/929; 423/415.1; 427/122; 428/408; 501/99</b>
<b>35</b>	<b>Copolymers having magnetic properties</b>	<b>528/422</b>	<b>528/271; 528/331; 528/391; 528/399</b>

	<b>Retrieval Classif</b>	<b>Inventor</b>	<b>S</b>	<b>C</b>	<b>P</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
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<b>36</b>	<b>Method for forming diamond-like nanocomposite or doped-diamond-like nanocomposite films</b>	<b>427/530</b>	<b>347/62; 423/446; 427/122; 427/570; 427/573; 427/574; 427/577; 427/578; 427/62; 427/905; 427/906; 428/408</b>
<b>37</b>	<b>Magnetic recording apparatus and magnetic head with superconducting material</b>	<b>505/171</b>	<b>360/125; 360/126; 505/701; 505/872</b>
<b>38</b>	<b>Thin-film transformer utilizing superconductive components</b>	<b>505/211</b>	<b>323/360; 335/216; 336/200; 336/DIG.1; 505/870</b>
<b>39</b>	<b>Gyromagnetic-effect cryogenic gyroscope for detecting angular velocity</b>	<b>505/160</b>	<b>324/160; 324/163; 324/248; 505/842; 505/872; 73/504.02; 74/5R</b>
<b>40</b>	<b>Superconductor magnetic reading and writing heads</b>	<b>505/171</b>	<b>360/120; 360/125</b>

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<b>40</b>	<b>US 4971947</b>	<input type="checkbox"/>

	<b>U</b>	<b>1</b>	<b>Document ID</b>	<b>Issue Date</b>	<b>Pages</b>
<b>41</b>	<input type="checkbox"/>	<input type="checkbox"/>	<b>US 4937227 A</b>	<b>19900626</b>	<b>5</b>
<b>42</b>	<input type="checkbox"/>	<input type="checkbox"/>	<b>US 4927804 A</b>	<b>19900522</b>	<b>7</b>
<b>43</b>	<input type="checkbox"/>	<input type="checkbox"/>	<b>US 4902428 A</b>	<b>19900220</b>	<b>7</b>
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<b>45</b>	<input type="checkbox"/>	<input type="checkbox"/>	<b>US 3691539 A</b>	<b>19720912</b>	<b>4</b>

	<b>Title</b>	<b>Current OR</b>	<b>Current XRef</b>
<b>41</b>	<b>Thin-film magnetic head including an inductive transducing element</b>	<b>505/171</b>	<b>360/120; 360/126; 360/127; 505/701</b>
<b>42</b>	<b>Thin-film transformer and magnetic head provided with such a transformer</b>	<b>505/171</b>	<b>336/84R; 360/120; 360/126; 360/127</b>
<b>43</b>	<b>Method and apparatus for separating magnetic material</b>	<b>210/695</b>	<b>209/214; 209/223.1; 209/232; 210/222; 95/28; 96/2</b>
<b>44</b>	<b>Method of inhibiting hillock formation in films and film thereby and multilayer structure therewith</b>	<b>257/32</b>	<b>257/734; 257/E21.295; 257/E21.591; 257/E23.157; 257/E23.159; 327/528; 505/874</b>
<b>45</b>	<b>SUPERCONDUCTIVE DEVICE FOR ELECTRONIC STORAGE OF LARGE QUANTITIES OF DATA USING MAGNETIC PARTICLES</b>	<b>365/160</b>	<b>327/528; 505/832</b>

	<b>Retrieval Classif</b>	<b>Inventor</b>	<b>S</b>	<b>C</b>	<b>P</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>41</b>		<b>Enz, Ulrich E. et al.</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>42</b>		<b>Zieren, Victor et al.</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>43</b>		<b>Cohen, Henry E.</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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	<b>Image Doc. Displayed</b>	<b>PT</b>
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	<b>U</b>	<b>1</b>	<b>Document ID</b>	<b>Issue Date</b>	<b>Pages</b>
<b>1</b>	<input type="checkbox"/>	<input type="checkbox"/>	<b>US 5728481 A</b>	<b>19980317</b>	<b>15</b>
<b>2</b>	<input type="checkbox"/>	<input type="checkbox"/>	<b>US 5109312 A</b>	<b>19920428</b>	<b>15</b>
<b>3</b>	<input type="checkbox"/>	<input type="checkbox"/>	<b>US 5097243 A</b>	<b>19920317</b>	<b>7</b>
<b>4</b>	<input type="checkbox"/>	<input type="checkbox"/>	<b>US 4937227 A</b>	<b>19900626</b>	<b>5</b>
<b>5</b>	<input type="checkbox"/>	<input type="checkbox"/>	<b>US 4927804 A</b>	<b>19900522</b>	<b>7</b>

	<b>Title</b>	<b>Current OR</b>	<b>Current XRef</b>
<b>1</b>	<b>Spin interaction device</b>	<b>428/694ML</b>	<b>428/694IS; 428/694MM; 428/694RE; 428/694SC; 428/694TM; 428/701; 428/702; 428/900; 501/126; 501/152; 505/190; 505/238</b>
<b>2</b>	<b>Magnetic recording apparatus and magnetic head with superconducting material</b>	<b>505/171</b>	<b>360/125; 360/126; 505/701; 505/872</b>
<b>3</b>	<b>Thin-film transformer utilizing superconductive components</b>	<b>505/211</b>	<b>323/360; 335/216; 336/200; 336/DIG.1; 505/870</b>
<b>4</b>	<b>Thin-film magnetic head including an inductive transducing element</b>	<b>505/171</b>	<b>360/120; 360/126; 360/127; 505/701</b>
<b>5</b>	<b>Thin-film transformer and magnetic head provided with such a transformer</b>	<b>505/171</b>	<b>336/84R; 360/120; 360/126; 360/127</b>

	<b>Retrieval Classif</b>	<b>Inventor</b>	<b>S</b>	<b>C</b>	<b>P</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>1</b>		<b>Kasai, Masahiro et al.</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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<b>3</b>		<b>Zieren, Victor et al.</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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# United States Patent [19]

Ruigrok et al.

[11] Patent Number: 4,907,115

[45] Date of Patent: Mar. 6, 1990

[54] **SUPER CONDUCTING THIN-FILM  
MAGNETIC HEAD INCLUDING A  
MAGNETORESISTIVE ELEMENT**

[75] Inventors: **Jacobus J. M. Ruigrok; Victor  
Zieren**, both of Eindhoven,  
Netherlands

[73] Assignee: **U.S. Philips Corp.**, New York, N.Y.

[21] Appl. No.: **218,009**

[22] Filed: **Jul. 12, 1988**

[30] **Foreign Application Priority Data**

Jul. 15, 1987 [NL] Netherlands ..... 8701663

[51] Int. Cl.<sup>4</sup> ..... **G11B 5/30**

[52] U.S. Cl. .... **360/113; 360/126;  
505/872**

[58] Field of Search ..... **360/113, 126; 505/872,  
505/845, 846**

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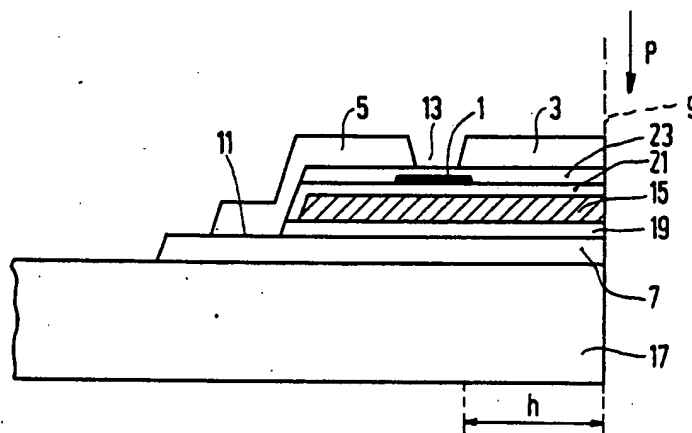
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*Primary Examiner*—A. J. Heinz  
*Attorney, Agent, or Firm*—William L. Botjer

[57] **ABSTRACT**

Thin-film magnetic head including a magnetoresistive element (1) and a face (9) for magnetically coupling the element with a magnetic recording medium. A magnetic yoke constituted by three layers (3, 5, 7) of a magnetically permeable material has a gap (13) which is bridged by the magnetoresistive element. A layer (15) of a superconducting material for improving the efficiency of the magnetic head is provided between the layers (3) and (5) and the element (1) on the one hand and the layer (7) on the other hand. For protection from external disturbing magnetic fields and reduction of stray flux a layer (43A, 43B, respectively) of a superconducting material is provided on the layers (3) and (5) and under the layer (7).

**4 Claims, 1 Drawing Sheet**





US005109312A

**United States Patent** [19]

Kato et al.

[11] **Patent Number:** 5,109,312[45] **Date of Patent:** Apr. 28, 1992

[54] **MAGNETIC RECORDING APPARATUS AND  
MAGNETIC HEAD WITH  
SUPERCONDUCTING MATERIAL**

[75] **Inventors:** Takahiko Kato, Katsuta; Jiro Kuniya,  
Hitachi; Takao Imagawa, Sendai;  
Katsuzo Aihara, Hitachiota, all of  
Japan

[73] **Assignee:** Hitachi, Ltd., Tokyo, Japan

[21] **Appl. No.:** 495,095

[22] **Filed:** Mar. 19, 1990

[30] **Foreign Application Priority Data**

Mar. 20, 1989 [JP] Japan ..... 1-66226  
Jan. 17, 1990 [JP] Japan ..... 2-6124

[51] **Int. Cl.:** ..... G11B 5/147; G11B 5/133;  
G11B 5/55; H04B 3/28

[52] **U.S. Cl.:** ..... 360/126; 360/125;  
360/106; 505/872; 505/701; 505/1

[58] **Field of Search** ..... 360/126, 106, 125;  
505/1, 800, 872, 701

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4,937,227 6/1990 Enz et al. .... 360/126  
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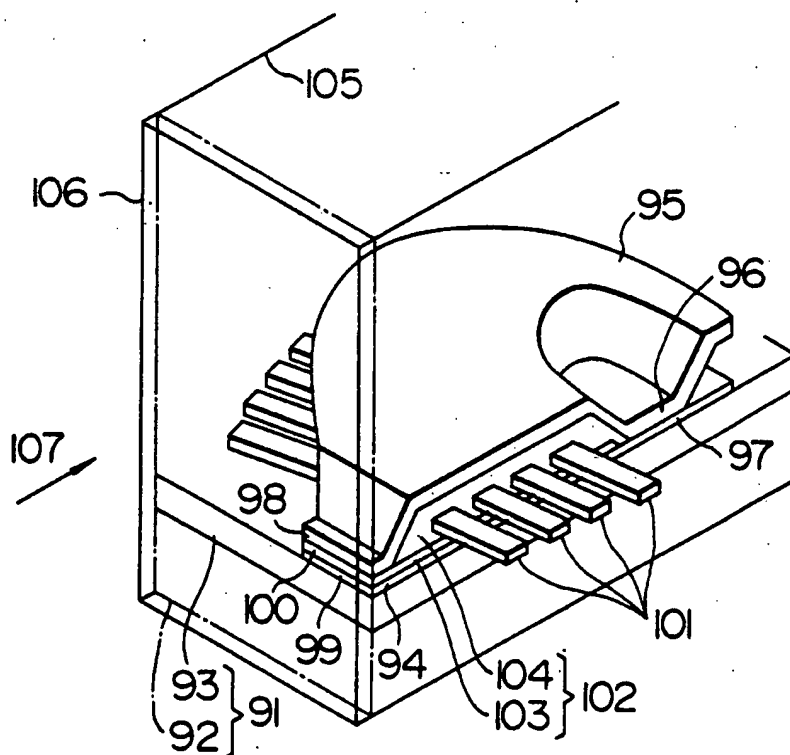
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64-1139 5/1989 Japan .

*Primary Examiner*—John H. Wolff*Assistant Examiner*—Craig A. Renner*Attorney, Agent, or Firm*—Antonelli, Terry, Stout &  
Kraus[57] **ABSTRACT**

A magnetic recording apparatus with a magnetic head, superconductive layers formed over at least flux generating surfaces of the magnetic head and normal conductive regions of small size for passing the flux provided in the superconductive layers, over the flux generating surfaces, so as not to form a closed magnetic circuit so as to enable reversible spontaneous magnetization in a magnetic recording medium proximate thereto. The minimum unit size (recording wavelength) of the reversible spontaneous magnetization in magnetic recording of the magnetic recording medium can be reduced from the order of 1  $\mu\text{m}$  to that of 0.1  $\mu\text{m}$ . Thus it is possible to increase the surface recording density of the magnetic recording medium utilizing more than 100 Mb/in<sup>2</sup>, comparable to the density achieved by the opto-magnetic recording. This in turn makes it possible to provide a large disc apparatus having a capacity of 60 MB or more.

**14 Claims, 7 Drawing Sheets**



US005097243A

**United States Patent** [19]

Zieren et al.

[11] **Patent Number:** 5,097,243[45] **Date of Patent:** Mar. 17, 1992[54] **THIN-FILM TRANSFORMER UTILIZING  
SUPERCONDUCTIVE COMPONENTS**[75] **Inventors:** Victor Zieren; Jacobus J. M.  
Ruigrok, both of Eindhoven,  
Netherlands[73] **Assignee:** U.S. Philips Corp., New York, N.Y.[21] **Appl. No.:** 491,393[22] **Filed:** Mar. 8, 1990

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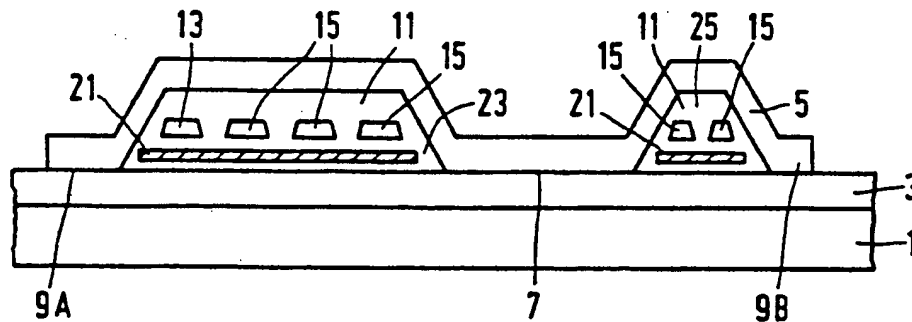
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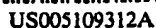
**Related U.S. Application Data**[63] Continuation of Ser. No. 218,013, Jul. 12, 1988, Pat.  
No. 4,927,804.[51] **Int. Cl.<sup>5</sup>** ..... H01F 5/00; H01F 36/00[52] **U.S. Cl.** ..... 336/200; 505/1;  
505/870; 336/DIG. 1; 335/216; 323/360[58] **Field of Search** ..... 336/200, DIG. 1, 84 R;  
335/216; 323/360; 505/1, 701, 867, 868, 869,  
870; 360/122, 123, 125, 126, 127, 128[56] **References Cited****U.S. PATENT DOCUMENTS**

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4,135,127	1/1979	Khanna et al.	323/360

**Primary Examiner**—Leo P. Picard**Assistant Examiner**—Bot Lee Ledynh**Attorney, Agent, or Firm**—William L. Botjer[57] **ABSTRACT**

Thin-film transformer, for example suitable for use in a thin-film magnetic head, comprising a magnetic yoke composed of two magnetically permeable thin layers 3 and 5 and a primary turn constituted by an electrically conducting thin layer 13 and a secondary turn constituted by an electrically conducting thin layer 15. A thin layer 21 of a superconducting material is provided between the layer 3 and the said turns, or the turns are closely fitted together and made of a superconducting material themselves.

**6 Claims, 2 Drawing Sheets**



[11] Patent Number: 5,109,312

[45] **Date of Patent:** Apr. 28, 1992

- 4,979,064 12/1990 Mage et al. .... 360/125

- ## FOREIGN PATENT DOCUMENTS

- 64-1139 5/1989 Japan .

- Primary Examiner—**John H. Wolff  
**Assistant Examiner—**Craig A. Renner  
**Attorney, Agent, or Firm—**Antonelli, Terry, Stout & Kraus

- [57]
- ABSTRACT**

- A magnetic recording apparatus with a magnetic head, superconductive layers formed over at least flux generating surfaces of the magnetic head and normal conductive regions of small size for passing the flux provided in the superconductive layers, over the flux generating surfaces, so as not to form a closed magnetic circuit so as to enable reversible spontaneous magnetization in a magnetic recording medium proximate thereto. The minimum unit size (recording wavelength) of the reversible spontaneous magnetization in magnetic recording of the magnetic recording medium can be reduced from the order of  $1\text{ }\mu\text{m}$  to that of  $0.1\text{ }\mu\text{m}$ . Thus it is possible to increase the surface recording density of the magnetic recording medium utilizing more than  $100\text{ Mb/in}^2$ , comparable to the density achieved by the opto-magnetic recording. This in turn makes it possible to provide a large disc apparatus having a capacity of  $60\text{ MB}$  or more.

- 14 Claims, 7 Drawing Sheets**

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|-----------|---------|---------------------|----------|
| 4,907,115 | 3/1990  | Ruigrok et al. .... | 360/126  |
| 4,926,082 | 5/1990  | Barnes .....        | 360/106  |
| 4,927,804 | 5/1990  | Zieren et al. ....  | 360/126  |
| 4,935,403 | 6/1990  | Yamaoki et al. .... | 346/74.2 |
| 4,937,227 | 6/1990  | Enz et al. ....     | 360/126  |
| 4,971,947 | 11/1990 | Barnes et al. ....  | 360/125  |

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# United States Patent [19]

Ruigrok et al.

[11] Patent Number: 4,996,621

[45] Date of Patent: Feb. 26, 1991

[54] SUPERCONDUCTING DEVICE FOR  
READING INFORMATION FROM A  
MAGNETIC RECORDING MEDIUM

[75] Inventors: Jacobus J. M. Ruigrok; Victor  
Zieren, both of Eindhoven; Ulrich E.  
Enz, Geldrop; Willem F.  
Druyvesteyn, Eindhoven, all of  
Netherlands

[73] Assignee: U.S. Philips Corporation, New York,  
N.Y.

[21] Appl. No.: 265,362

[22] Filed: Oct. 28, 1988

[30] Foreign Application Priority Data

Nov. 2, 1987 [NL] Netherlands ..... 8702607

[51] Int. Cl.<sup>5</sup> ..... G11B 5/147

[52] U.S. Cl. .... 360/126; 324/248;  
505/845

[58] Field of Search ..... 360/110, 113, 125, 126;  
324/248, 249; 505/845

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U.S. PATENT DOCUMENTS

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Primary Examiner—A. J. Heinz

Attorney, Agent, or Firm—Bernard Tiegerman

[57] ABSTRACT

Device is provided for reading information from a magnetic recording medium, comprising a SQUID (15), a magnetic yoke formed from two flux guides (3 and 5) and a face (13) for magnetic flux coupling of the SQUID with the magnetic recording medium. The SQUID is provided with connection means (33) for a detection circuit (35).

17 Claims, 3 Drawing Sheets

